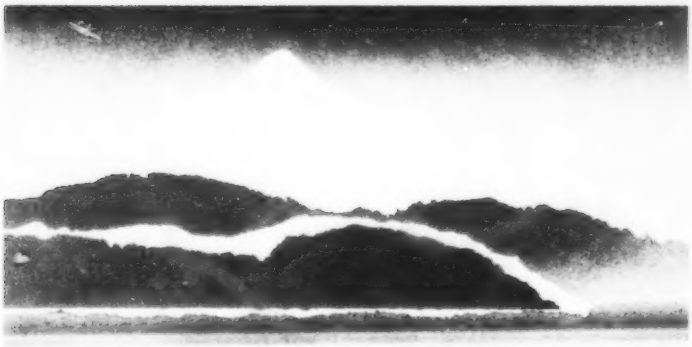
TSUNAMI ANNOTATED BIBLIOGRAPHY



BC Environment
Water Management Division

PROVINCE OF BRITISH COLUMBIA
Ministry of Environment, Lands and Parks
Floodplain Management Branch

TSUNAMI

Annotated Bibliography

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INTRODUCTION

This selected annotated bibliography was prepared for internal use by the Ministry of Environment, Lands and Parks (MELP) of the Province of British Columbia, as background to a study of the regulation of development of hazardous coastal lands.

Tsunamis commonly originate from major underwater seismic events which have historically occurred around the Pacific Rim. In certain coastal locations, especially at the heads of inlets, the maximum water elevation from historical tsunami events exceeded maximum astronomical tide, storm surge or riverine flood elevation. Tsunamis are a series of waves lasting up to 24 hours and superimposed on the natural tide. The resulting maximum water level may therefore be from any combination of tide and tsunami, as well as the wind setup.

The bibliography includes:

- The nature of tsunamis, generation, propagation and termination
- Astronomical tides, storm surges
- The statistics of historical infrequent events and risk analysis
- Coastal Management in other jurisdictions, especially the west coast of North America and Hawaii
- Tsunami warning systems
- Regulation in British Columbia
- Construction in high hazard zones.

Between 1962 and 1992 about 300 papers have been published on tides, storm surges, tsunamis and coastal oceanographic problems. There are many other references in the academic and popular press. In addition, there are numerous papers and books on coastal management and regulation of hazardous lands. This bibliography includes a selection of major references with an emphasis on regulatory criteria and techniques for the construction of residential/commercial buildings. The author acknowledges the assistance of the staff at the MELP Library, Victoria, and the Institute of Ocean Sciences Library, Sidney, B.C. For further references the reader may access the usual on-line sources such as DOBIS, GEOBASE, GEOREF, COMPENDEX, WATDOC, etc.

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Note: The symbols FL, RB, ML, LL, IOS, WMD, VL, are for internal use.

ANNOTATED BIBLIOGRAPHY

(Listed by Category)

A. GENERAL DESCRIPTION OF TSUNAMIS, EARTHQUAKES, TSUNAMI WARNING PLANS, RISK ANALYSIS

Ayre, Robert S., Mileti and Trainer, Earthquakes and Tsunami Hazards in the United States, a research assessment, Institute of Behavioral Science, University of Colorado, 149 pp., 1975 (LL, RB).
Part 1 is about earthquakes. Part 2 describes tsunami; unpredictable, potentially devastating even after crossing the Pacific Ocean. Types of damage to fixed and movable materials also local ecology and economy. Coastal B.C. at risk esp. up narrowing inlets. It is difficult but necessary to define areas at risk. Adjustments to the risk include zoning, structural design, warning and evacuation. The Pacific and local warning systems are described in detail; limitations are noted, community preparedness, insurance, rehabilitation. Simulation of tsunami loss management is discussed.

Brandsma, Divosky and H. Wang, Tsunami Atlas for the Coasts of the United States, Tetra Tech Inc., 1979 (RB. LL).
A study to determine the distribution of wave heights and time histories due to distant hypothetical tsunamis. Good descriptions of plate tectonics, generation, propagation, etc.

Campbell D. D. and Rotzien J. L. Deterministic Basis for Seismic Design in B.C. in Geotechnique and Natural Hazards 1992. Pub. Bi Tech Pub. Ltd, Vancvouer, B.C. p. 71 - 79 (FL). *The authors present a seismic hazard map for British Columbia, justified by the latest information on seismic monitoring, measuring and understanding of the earth's crust. They do not agree that there is high potential for a seismic event of M 9.0 or greater off Vancouver Island.*

Civil Defence B.C., Tidal Wave - Summer 1964, Province of British Columbia, 38 pp (RB).
Description of damage, photographs, civil defense response for the tsunami at Port Alberni. Report covers welfare, military, Salvation Army, City and other involvement on a daily basis.

Cox, Doak C.,Investigations of Tsunami Hydrodynamics, H.I.G. Report No.43, U.S. Office of Naval Research, 1963, 15pp (RB).
Background to research needs; of general and historical interest esp. re monitoring wave heights in harbours and oceans.

Curtis, George D., Hawaii Tsunami Inundation/Evacuation Map Project. Final Report. 27 pp Hawaii State Civil Defense Agency, 1991, (FL).
Preparation of maps for 680 km of coastline, based on calculated run up from historical and estimated wave height; methodology described. A long, local history of tsunami damage is the reason for such a major effort. Copies of the maps are printed in telephone directories.

Dohler, G.C. (Chairman, I.Ts.U.), Tsunami - Where Next?, Canadian Hydrographic Services Publication, 1983 (FL).
Describes the Pacific Tsunami Warning System goals, history, warning centres, telemetry systems, charts showing tsunami propagation speed, illustrations.

Golder Associates, Report on Investigation of Seawave at Kitimat B.C. (on April 27, 1975), with maps June 1975 (FL)
A large (3 million c.y.) landslide caused a tsunami in Douglas Channel resulting in damage to a dock. The wave height was 25 ft. (7.6 m.) at Kitimat Village.

Graham, D., Lights of the Inside Passage, Harbour Publishing, B.C., 1986.
Describes damage from extreme height storm-generated waves. Important to understand that these waves may be far higher than tsunamis on isolated coasts. (Also see Victoria Times-Colonist, *Jan. 7, 1992.)*

Hamilton, T.S., The Foreslope Hills of the Fraser Delta; Implications for Tsunamis in Georgia Strait, Geological Survey of Canada, No. 30886, Sidney, B.C.; in Science of Tsunami Hazards. Vol. 5, No. 1, 1987 (FL).
A major slide on one of these underwater slopes on the face of the Fraser Delta could cause a tsunami in Georgia Strait., affecting dyked areas such as Richmond. This source is unlike the more normal tectonic plate seismic event that has caused most historical tsunami.

Hammack Jr., J.L., Tsunamis, A model of their Generation and Propagation, Cal. Inst. of Tech., 1972 report KH-R-28 260 pp - (IOS).
Theoretical and experimental modelling. Limitations of the linear theory.

------- and Raichen, F., Long Waves Generated by Complex Bottom Motions, in Coastal Engineering Proc. Vol. 1, 1980, p. 639 - 651 (IOS).
When modelling tsunami generation, simple bottom motions are normally used. The authors examine records of ground motion for a 1971 earthquake to demonstrate the validity of superposition when there is a complex source.

Hodgson, Ernest A., British Columbia Earthquake June 23, 1946, pub. Journal Royal Astronomical Soc. of Canada, Vol. XL, No. 8, 34 pp. and 40 photos. October, 1946 (RB).
Describes tsunami at Alberni Canal plus details of all damage due to this earthquake.

Ingles, O.G., Statistics and Probability: The Engineer-Client Interaction Problem in Proc. ICASP5 - 5th Int. Conf. on Stats. and Prob. in Soil and Struct. Eng. U.B.C. Vancouver, B.C. Can., 1987 p. 12 - 23 (FL).
Research and professional dissemination of the risk inherent in engineering work is well advanced, but the public and client-related aspect is not. Problems of definitions, the value of life, insufficient data, inference, supervision; some possible solutions are suggested.

Ito, Yoshiyuki, On the effect of Tsunami Breakwater in Coastal Engineering in Japan, Vol. 13, 1970 p. 89 - 102 (FL).
Several ports in Japan have anti-tsunami breakwaters to reduce energy or water level in the basin. The performance of the Ofunato system was observed during the May 1968 tsunami and is compared to the design method.

Jordaan, I.J., Risk and Safety Assessment for Arctic Offshore Projects, from Proc. 2nd Ann. MIT Sea Grant College Program, M.I.T. Cambridge, Mass., U.S.A. p. 81 - 88, 1983 (FL).
Risk analysis is a systematic procedure requiring estimation of probabilities and an analysis of consequences of the event. Practical guides for dealing with the problems of risk are discussed.

Koyama. J., Suzuki, Z., Extreme Values of Tsunami Magnitudes, Proc. Int. Tsunami Symp. 1985, Sydney B.C. 99 pp (FL).
Global earthquake-magnitude data (Ms) for 1130 major

earthquakes for the period 1897 to 1980 is statistically analyzed for extreme values and hence the magnitude of the largest possible earthquakes. The maximum value of earthquake magnitudes is closely related to the size of earthquake sources. The largest tsunami magnitude ever registered in each seismic region is a good measure for a tsunami hazard reduction program. The 1964 Alaska earthquake was exceptionally large, beyond the statistical estimations for the Alentian-Alaska region, based on 74 recorded earthquakes. The tsunami was also unexpectedly large.

Miller, G., Tsunamis and Tides, pub. University Microfilms International, Ann Arbor, Mich., U.S.A., 1964, 120 pp (IOS).
Compares harmonically forced steady-state tides and impulsively generated decaying tsunamis, spectra, fluctuations in decay curves.

Murty, Dr. T., Seismic Sea-Waves, Tsunami, Bulletin 198 of Fisheries Research Board of Canada, 337 p., 1977 (ML, parts in RB).
Complete book on tsunami; generation, propagation, coastal action, global tsunamis, warning systems; seismology - a thorough general dissertation on world-wide events.

-------, Marine Hazards: in Proc. of Geologic Hazards in B.C., conference 1991 Victoria, B.C. (FL).
A general up-date on the tsunami risk, studies, modelling for B.C.

-------, Tsunami Threat to the British Columbia Coast; in Proc. of Geologic Hazards Conference 1992, Vancouver, B.C. (FL)
Reviews past studies by Dunbar, Ng, covering the impact of distant and near-shore seismic events. He also discusses his current work with Kowalik, refining estimates for the Alberni Canal. Need to combine tsunami with tides.

Myles, Douglas, The Great Waves, McGraw Hill 1985 (IOS).
Written in a popular style, this book has extensive information on tsunami; the geology, tectonics, history, major tsunami records, and warning systems. An excellent introduction to the awesome force of these waves.

Obee, Bruce, article, Canadian Geographical Magazine, Feb./March 1989(FL).
General interest, good illustrations.

Pack, R.T., Morgan, G.C., and Anderson, L.R., Philosophy of Landslide Risk Evaluation and Acceptance in Proc. ICASP5 - 5th Int. Conf. on Stats. and Prob. in Soil and Struct. Eng., U.B.C.,

Vancouver, B.C., Can., 1987 p. 947 - 952.
The analysis of landslide risk should involve risk identification, evaluation, acceptance and mitigation. The evaluation should cover trigger, failure, exposure and consequences. Judgement can and should be supported by such an analysis. Voluntary and involuntary risk levels are compared.

Pararas-Carayannis, G., Tsunami Hazard and Design of Coastal Structures, in Proc. 15th Coastal Eng. Conf., 1976, p. 2248-53 (IOS) Pub. Am. Soc. Civil Eng.
Damage to coastal structures can occur by hydrostatic and dynamic pressures, foundation failure, overtopping and flooding. Reliable prediction of the tsunami hazard is essential for design of structures and for hazard evaluation. A combination of theoretical, empirical and historical methods are used. Studies of high quality are expensive and normally only justified by major projects. Runup, terminal velocity and periodicity are important parameters for structures. Frequency analysis of historical events is a useful analytical tool for the study of tsunami.

Pond, S. and Pickard G.L., Introductory Dynamical Oceanography. Pergamon Press, 1983. (329 pp) (FL)
Text book for understanding tides and sea waves, relationship to tsunami, measurement and prediction of water levels, resonance in bays and estuaries.

Pugh, D.T., Tides, Surges and Mean Sea-Level, Wiley, 1987, 472 pp. (IOS).
A handbook for engineers and scientists. Chapter on estimating probability of extreme values. Hurricanes and tsunami are too rare to permit the calculation of reliable probabilities. A better method is to model the tsunami with tidal variation, for the point of interest.

Rogers, G.C., Megathrust potential of the Cascadia Subduction Zone, Can. Jour. Earth Sciences, June 1988, 31 pp. (FL).
The Cascadia zone is west of Vancouver Island. A major seismic event could cause a devastating tsunami. The geology of the zone is compared with other young zones. The possibility of large seismic events is discussed.

Saxena, N.K. and Murty, T.S., Tsunami Research - a Review and New Concepts, in Natural and Man-Made Hazards, p. 163 - 170, 1988 pub. D. Reidel.
The tsunami warning system is not satisfactory because tsunami cannot be predicted as to size. False alarms are

costly. Observations of the deep water passage of the wave are needed. Bathymetric data is inadequate, resulting in inaccurate travel-time charts. Problem of tsunami generation from local earthquakes.

Shuto, Nobuo, Summary of Effect and Limit of Tsunami Control Forest Dept. of Civil Eng., Tohoku Univ. Japan, in Proc. In. Ts. Symp. 1985, p. 221 - 224 (FL).
Shoreline planting has been used as a protective device against tsunami, to reduce velocity and depth, however these same trees may become damaging debris in the event of a very large wave.

Smyth, K.K.W., Lecture Notes, Tsunami & Alluvial Fans 1983, MELP (FL).
Text and projection slides for lectures.

Soloviev, S.L. and Go, Ch.N. Catalogue of Tsunamis on the Eastern Shore of the Pacific Ocean Nanka Publishing House, Moscow, U.S.S.R. 204 pp., 1974, Can. Trans. 1984, Fish. Aquat. Sci. No. 5078 (FL).
Contains descriptions of about 600 tsunami and related phenomena, observed on the northern and western coasts of the Pacific Ocean; locations, intensities and locations of the seismic event foci. Sources for the descriptions are listed and primary sources identified for each event. A companion volume covers the Western Shore, including the Alaska-Aleutian area.

Thomson, R.E., Oceanography of the British Columbia Coast, Federal Dept. of Fisheries & Oceans, Canada, 1981 (ML, part RB).
Well written, comprehensive, 7 pp. on tsunami, good introduction.

Underwriters, National Board of, The Alaska Earthquake, published by the N.B.F.U. and the Pacific Fire Rating Bureau 1964, 35 pp. (FL).
Illustrated booklet describing earthquake and tsunami damage due to the 1964 event.

U.S. Dept. of Commerce, Annotated Bibliography of Tsunamis (1836 - 1948), by Marcial P. Cuellar, for the Corps. of Engineers, Washington, D.C., 1953, 69 pp. (LL)
195 annotated entries with an index of geographic names and authors. The frequency of entries for the Aleutians, Arica (S. America), Chile, Hawaiian Islands (26 entries) and Japan (47 entries) are a measure of the serious nature of this natural hazard to those areas.
The study of tsunamis was related to seismic events; breakages to undersea cables were frequently noted as an

indication of submarine slides. The Lagrange formula ($V=\sqrt{gH}$) was used in the 1856 report of the U.S. Coast Survey with marigram data to determine the average velocity of propagation across the Pacific. Many centuries of tsunami in Japan provided material for study by scholars of learned societies and earthquake institutions using theoretical and physical modelling methods to investigate tsunami generation and propagation and harbour oscillations. Following the 1946 disaster and the confidence in time-of-travel prediction, the Pacific Warning System was developed.
This bibliography provides a history of the early study of tsunami. Subsequent developments were the use of computers and an understanding of the tectonic plate theory.

-------, Coast & Geodetic Survey, Tsunami!, The Story of the Seismic Sea-Wave Warning System 1965, 46 pp. (IOS)
Illustrated booklet for general distribution. Numerous photographs and sketches as background to the seismic warning system. Reprints actual messages sent in 1964 re: Alaska event. Good dramatic educational material. Importance of local organization and warning system.

-------, (Nat. Oceanic & Atmos. Admin.) Tsunami! The Great Waves 1975 (19 pp.) (FL).
Booklet with good illustrations describes seismic and tsunami waves in relation to the warning system.

-------, (Nat. Geophysical Data Center) Natural Hazards Photograph Catalog Doc. No. 20 Boulder, Col. 1984, 97 pp. (FL).
Historical photographs are indexed by date with brief description. Earthquakes, tsunami and volcanoes. Some photos reproduced. Slides of photos can be ordered.

U.S. Dept. of Commerce, United States Tsunamis 1690 - 1988, National Geophysical Data Center, Boulder, Col., 1989, 265 pp. (LL, excerpts RB).
"An important part of risk assessment is the understanding of the effects of past tsunamis." Building on past catalogues, the authors have assembled all that is known and rated sources by a "validity scale". Problems with standard time and calendar make it difficult to match historical tsunamis with seismic events. Comprehensive description of tsunamis, causes, seiches, illustrations, maps. etc.

White, W.R.H. The Alaska Earthquake - Its Effect in Canada Canadian Geographical Journal, June 1966 p. 210 - 219 (FL).
Illustrated report of damage from 1964 event in B.C.; map

shows extent of flooding in Alberni-Port Alberni. Primary source for damage. Mr. White was a staff member at the Dom. Astro. Observatory Victoria.

Wigen, S.O., Tsunamis, B.C. Professional Engineer, January 1981, p. 6 - 8 (FL).
Summary of history of tsunami and damage, illustrated. Recommends public education, warning, evacuation.

Wilson, B.W. and Tørum, A. The Tsunami of the Alaskan Earthquake, 1964: Engineering Evaluation U.S. Army Corps of Engineers, Coastal Eng. Res. Centre Tech. Mem. No. 45, 1968, 400 pp. (LL).
A very complete and detailed technical description of the wave mechanisms and damage, fully illustrated. Speculates on the relationship of sun-moon orientation to seismic event frequency. Analysis of water velocity vs. wave height, eg. velocity needed to overturn a locomotive. The horizontal and vertical movement of the land at the area of seismic disturbance confused observations. Emphasis on nature and reason for damage at all West Coast U.S.A. and New Zealand.

ARTICLES, PROCEEDINGS

Earthquake, Data Services and Publications, Geo. Rec. Doc. No. 15, National Geophysical Data Centre, Boulder Col. 1983. (FL)
Describes sources of data re. tsunami.

Master Plan for the Tsunami Warning System in the Pacific, Intergovernmental Oceanographic Commission of UNESCO, Paris, 1987 32 pp FL.
Describes the extent and nature of tsunami damage, the need for and how warning systems function and a Master Plan.

Proceedings Int. Symp. on Tsunamis and Tsunami Research at Univ. of Hawaii, 1969, W.M. Adams, editor, 513 pp. 1970 (IOS).
34 papers covering seismic source and energy transfer, instrumentation, propagation and run-up, and general reports on tsunami research.

Proceedings Tsunami Symposium Canberra, Australia 1979, pub. Griffith University, Queensland, Australia and I.O. Comm. 284 pp. (IOS).
14 papers on modelling, warning systems.

Proceedings International Tsunami Symposium, Tsunamis, Their Science

and Engineering, at Sendai-Ofunato-Kamaishi, Japan 1981, pub. Terra Scientific Publishing Co. Tokyo. (IOS)
39 papers on tsunami impact, source, statistical studies, generation and propagation, topographic effects, sea walls and breakwaters, run-up.

Proceedings of the International Tsunami Symposium, Sidney, B.C. 1985, Murty and Rapatz, ed., 323 pp., (IOS).
59 papers and abstracts on generation, propagation, warning systems, wave forces, run-up, coastal response, energy loss.

Preuss, J. and Hebenstreit, G.T., Integrated Hazard Assessment for a Coastal Community, Grays Harbor, Wash. U.S.A., 1990. pub. Urban Regional Research, Seattle, Wash. (IOS).
The tsunami flood initiates a series of damage events, including fire and toxic/hazardous release. The zone of vulnerability and secondary hazards should be identified for a complete risk management plan. At this site, tsunami and high river levels are combined,

Science of Tsunami Hazards, International Journal of the Tsunami Society, Dr. T.S. Murty, Technical Editor, 1990 (FL).
Records of current tsunami and response with technical papers. eg. from Vol. 8, No. 2.
1. *Tsunami Travel time Charts for the Caribbean*
2. *Numerical Tsunami Flooding Study (Mader)*
3. *Numerical Simulation of Tsunami Amplitudes on the Coast of B.C. due to Local Earthquakes (Ng, LeBlond, and Murty).*

Each of these articles have matters of interest. Others are cited by author in this bibliography.

Seismic Risk in B.C., Brief to the B.C. Government, Assn. of Professional Engineers of B.C., 1988, 27 pp. (FL).
Increasing knowledge of the seismic risk in B.C. and the nature of the expected damage both primary and secondary (eg. tsunamis, fires) points to the need for active preparation rather than just response.

The Alaska Earthquake of 1964, Field Investigations and Reconstructive Efforts, Geological Survey, Prof. Paper 541, 1966 (IOS)
Account of damage, etc., very good pictures, some in colour.

Tsunami Newsletter, International Tsunami Information Centre, Vol. XX, No. 2, December 1987 (FL).
1. *Describes an earthquake of R.7.5 in the Gulf of Alaska, with minor damage; probably because there was normal*

rather than subduction faulting.

2. *Report on the 11th Conference on Tsunami Warning, Beijing, national reports from countries, Seaconsult Study reported.*

(Additional Tsunami Newsletters on file.)

Tsunami Risk, brochure, Provincial Emergency Program, B.C. Ministry of Solicitor General (FL).
For public distribution. Describes potential for damage and emergency response.

Tsunami Video, VHS, Information Services Branch, B.C. Environment, Dec. 1987 (FL).
Prepared by Ministry, based on 1964 Port Alberni event.

Tsunami Warning Plan, B.C. Provincial Emergency Program, Ministry of Solicitor General, October, 1980 (FL).
Binder containing information on warning system, message formats, etc.

Tsunamis, Province of British Columbia, Provincial Emergency Program training Bulletin, 1987 9 pp. (FL)
Illustrated booklet describing tsunamis, damage and the Provincial warning system.

Video Tapes,

- *C.B.C., showing damage at Crescent City California, 1964 (FL).*
- *Tsunami Video, prepared for MELP*
- *Japanese Video, showing tsunami wave.*

B. RECORDS OF TSUNAMIS

Adams, W.M., Tsunami in the Pacific Ocean, Proc. Int. Symp. on Tsunamis and Tsunami Research, Univ. Hawaii 1969 (IOS).
Contains "the Tsunami in the Alberni Inlet caused by the Alaska Earthquake," Murty and Boilard (modelling of inlet), 1969 op. cit.

Hebenstreit G.T., and Murty, T.S., "Tsunami Amplitudes from Local Earthquakes in the Pacific Northwest Region of North America, Part 1, 145 pp. - The Outer Coast, Part 2 - Strait of Georgia, Juan de Fuca Strait and Puget Sound, Marine Geodesy, Vol. 13, pp. 101-146, Sept. 1989 (FL, RB).
Maximum tsunami amplitudes that will result from major earthquakes in the Pacific Northwest Region. Math. models used. Seismology of off-shore zones is discussed.

Spaeth, Mark G., and, Berkman Saul C., The Tsunami of March 28, 1964 as Recorded at Tide Stations, C&GS 33, U.S. Dept. of Commerce, 86 pp., 1967 (RB and IOS).
Description of the event and its impact with copies of every tidal gauge record of this event.

Wigen, S.O., The Tsunami of May 22, 1960, West Coast of Canada, Canadian Hydrographic service, 3 pp. with diagrams (IOS).
Tide records and observations (eg. at Shields Bay). Some damage reported from this event.

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Earthquake, Data Services and Publications, Geo. Rec. Doc. No. 15, National Geophysical Data Centre, Boulder, Col. 1983 (RB).
Describes sources of data re tsunami.

The Alaska Earthquake of 1964 - Field Investigations and Reconstructive Effort, U.S. Geological Survey Prof. Paper 541, 1966 (IOS).
Complete description of damage, good pictures.

C. TSUNAMI STUDIES WEST COAST OF CANADA

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Intertidal mud has buried vegetated lowlands in westernmost Washington at least six times in the past 7000 years. Each burial was probably caused by a rapid tectonic subsidence. Sheets of sand on top of three of the layers may be from tsunami inundations, evidence of earthquakes from the Cascadia subduction zone, off Washington and Vancouver Island.

Blakely, W.J., Some observations on planning for Tsunami Prone Areas (prepared for the City of Port Alberni) May 14, 1979 33 pp. (FL)
The results of a literature search and telephone interviews with authorities in communities affected by the 1964 tsunami. Covers post-disaster response and planning for future land use.

Dunbar, D., P.H. LeBlond and T.S. Murty, (1991) Evaluation of Tsunami amplitudes for the Pacific coast of Canada, Progress in Oceanography, 26, 115-177. (IOS)
Similar to Dunbar LeBlond and Hodgins (Seaconsult).

-------, P. LeBlond, D. Hodgins, Evaluation of Tsunami Levels Along the British Columbia Coast, Dept. of Fisheries & Oceans, Sidney, B.C., 198 ML.
Important mathematical modelling study ("Seaconsult Report") based on several distant seismic sources - only modelling for B.C. Coast (except Port Alberni). Distributed as summary to Regional Offices of MELP and affected communities.

Kowalik, Z. and Murty, T.S., Numerical simulation of two-dimensional Tsunami run-up, in preparation 1992.
State of the art mathematical model of Alberni Inlet; includes loss of energy due to run-up at shoreline discontinuity.

Heaton, T.H. and Hartzell, S.H., Earthquake Hazards on the Cascadia Subduction Zone in Science Vol. 235, 10 Apr. 1987, p. 162 - 168 (FL).
Large subduction earthquakes, which may be accompanied by large local tsunami, may originate at the Cascadia Subduction Zone west of Vancouver Island. The 1200 km. long zone is similar to other young zones in Chile, southwestern Japan and Columbia where there is seismic activity.

Hebenstreit and Murty, Tsunami Amplitudes from Local Earthquakes in the Pacific Northwest Region of North America, Marine Geodesy, Vol. 13, pp. 101-146, Sept. 1989 (FL, RB).
Maximum tsunami amplitudes that will result from major earthquakes in the Pacific Northwest Region. Math. models used. Seismology of off-shore zones is discussed. Fig. 2.2 has records for Washington and Oregon coasts.

Marshall, Macklin, Monaghan (MMM Study), Development Management in Tsunami Hazard Areas of Port Alberni, 1986, (FL).
Locally important study with hydraulic modelling of parts of Port Alberni; B.C. areas affected by flooding and current for 100- and 200-year events; current and future uses within the affected areas. This is the type of study recommended for OCP and zoning revision as well as consideration of major barrier works, internal drainage and emergency planning. Reviews legislative and administrative practice, examines options for action.

McCrae, A. and Reid Crowther, et al., Development Feasibility Study, Lugrin Creek Area, 1978, (FL).
A study of riverine flooding potential in the Alberni-Port Alberni B.C. area, but found that tsunami is a bigger threat. Analysis of tsunami risk by A. McCrae.

McLaren, Patrick, Tsunami Impact Mapping for the West Coast of Vancouver Island (unsolicited proposal), GeoSea Consulting, Victoria, B.C., 1986 (FL).
(Impact - meaning "environmental, recreational, demographic and cultural factors." Identify the "geographic distribution and degree of severity of impacts resulting from a tsunami impinging the shoreline.)

Murty, Dr. T. and Boilard, L., The Tsunami in the Alberni Inlet Caused by the Alaska Earthquake, (in Proceeding of Int. Symposium on Tsunami. 1969) (IOS).
The role of local resonance in the Alberni inlet; spectral analyses of several tidal-gauge records on the west coast of Canada to determine the energy in various frequency ranges. Estimates 1.1 foot additional height of water from a travelling storm, using Rao (1969); the effects of a breakwater are examined.

-------, Marine Hazards, in Proc. of Geologic Hazards in B.C., conference 1991 Victoria, B.C.(FL).
A general up-date on the tsunami risk, studies, modelling for B.C.

-------, Tsunami Threat to the British Columbia Coast, in Proc. of Geologic Hazards Conference 1992, Vancouver, B.C. (FL).
Reviews past studies by Dunbar, Ng, covering the impact of distant and near-shore seismic events. He also discusses his current work with Kowalik, refining estimates for the Alberni Canal. Need to combine tsunami with tides.

Ng, Max Kin-Fat, Assessment of Tsunami Hazards on the British Columbia Coast due to a Local Megathrust Subduction Earthquake, 125 p., pre-publication M.Sc., thesis, University of British Columbia, January 1990 (FL, RB).
Earthquake potential in the Pacific Northwest, west of Vancouver Island; hypothetical earthquake and resulting tsunami on west coast of Vancouver Island and Strait of Georgia.

-------, K. Max, P.H. LeBlond and T.S. Murty, Numerical Simulation of Tsunami Amplitudes on the Coast of British Columbia due to Local Earthquakes, 30 p., Dept. of Oceanography of UBC, also

Inst. of Ocean Sciences, Sidney, B.C., 1990 (FL).
Seismology of off-shore plates. Math. modelling of waves from hypothetical event. Potential for major damage.

Rapatz, W., Tsunami, re Seaconsult report, Victoria Times-Colonist, June 7, 1988 (FL).
"figures of height and current speed given for head of inlet should be multiplied by 0.7,"

Seaconsult Marine Research Ltd. (D. Dunbar, P. LeBlond, D. Hodgins), Evaluation of Tsunami Levels Along the British Columbia Coast, Dept. of Fisheries & Oceans, Sidney, B.C., 1988 (ML, IOS) (full version).
Important mathematical modelling study based on several distant seismic sources - only modelling for B.C. Coast (except Port Alberni). Distributed as summary to Regional Offices of MELP and affected communities.

Wigen, S.O., Tsunami Frequency at Tofino and Port Alberni, March '79 , report to MELP (RB, WMD No. 2771).
(Mr. Wigen was tsunami advisor to IOS.) 21 tsunamis were identified for Tofino and 6 for Port Alberni with statistical correlation. Analysis by Allan McCrae, P.Eng.; comparison with other Pacific locations.

-------, Tsunami Threat to Port Alberni prepared for A.M. McCrae and Reid Crowther Ltd., Feb. 1977, 39 pp. (FL).
Tabulation of tsunami records for Tofino and Port Alberni. Prepared for Lugrin Creek Study. Discusses forecasting based on historical records. Lists 114 earthquakes of R7.5 to R8.6, by source area, since 1900. Tidal charts examined for tsunami at Tofino and Port Alberni. Relationship between max. wave heights at Tofino and Port Alberni. Warns against extrapolating frequency of occurence. Near-shore event, R6.7, in 1976 did not cause a tsunami at Tofino.

-------, Historical Study of Tsunamis at Tofino, Canada from Tsunamis - Their Science and Engineering, Pub. Terra Scientific Publishing, Tokyo, 1983, 16 pp. (FL).
A search (in 1981) of 1500 tsunamigenic events recorded during 75 years revealed 43 tsunami at Tofino, ranging from 6 cm. to 240 cm. Events are tabulated and seismic sources shown on maps. Recurrence frequency is logarithmic.

------- and W.R.H. White, Tsunami of March 27-29, 1964 West Coast of Canada, Dept. of Mines and Technical Surveys, 6 pp., August, 1964 (RB, FL).

Primary source for damage, wave heights from 1964 tsunami.

Zirul, M.L., Preliminary Report on City of Alberni Flood Protection, BC MELP, WMD, Reports Library, No. 1212, Dept. of Lands, Forests & Water Resources, October 1964 (ML).
Includes discussion of tsunami threat.

Evaluation of Tsunami Levels along the B.C. Coast, Seaconsult Marine Research Ltd., 1988 (Summary at FL, full report at ML).
Math. modelling results. Best source for sites with no historical data. Describes limitations of math. modelling. Study cost $241,954.

Report on the Alberni Tidal Wave Disaster - 20 May 1964, Office of Provincial Civil Defence Coordinator (FL).
Description of the disaster ref. Port Alberni, pictures, interviews, emergency response.

Tidal Wave, Civil Defense Circular, Province of British Columbia, summer 1964 (RB).
Good description of the disaster with pictures and local response and organizational problems.

Tsunamis, Province of British Columbia, Provincial Emergency Program training Bulletin, 1987, 9 pp. (FL).
Illustrated booklet describing tsunamis, damage and the Provincial Warning System.

D. TSUNAMI MODELLING AND THEORIES

(also see Section C, Tsunami Studies, West Coast of Canada)

Bernard, E.N., Tsunami Hazard, A practical guide for Tsunami Hazard Reduction, reprinted from Natural Hazards, Vol. 4, Nos. 2 & 3 (1991). Kluwer Academic Publications, 326 pp. (IOS).
13 papers presented at the 14th Int. Symp. on Tsunami 1989, Novosibirsk, U.S.S.R. Papers on observations (eg. 1987-88 Alaska Events), propagation, run-up, modelling, bores.

Brandsma, Divosky and H. Wang, Tsunami Atlas for the Coasts of the United States, Tetra Tech for U.S. Nuclear Reg. Comm., 1979 (RB. LL).
As the first step in estimating the worst case high or low water level on Pacific or Atlantic coasts for power plants. Uses a very large seismic event at various locations; tsunami wave is generated and propagated to the coast, resulting in wave traces off-shore at 600 feet depth. Full descriptions of plate tectonics, wave generation and mathematics of propagation.

Bretschneider, C.L. and Wybro, P.G., Tsunami Inundation Prediction, in Proc. 15th Coastal Eng. Conf. 1976, p. 1006 - 1024, pub. Am. Soc. Civil Eng. (IOS)
Assuming a wave elevation at the coast, discusses the run-up and inundation characteristics of the tsunami surge. Need to estimate bed roughness, foreshore and backshore slope. Manning 'n' values are given for various conditions and results are compared with observations in Hawaii.

Camfield, F.E., Tsunami Engineering, U.S. Army Corps. of Engineers, Coastal Eng. Res. Centre. Sp. Rep. No. 6, 1980, 222 pp. (ML).
Mathematical treatment of generation, propagation and run-up; importance to an understanding of the nature of tsunami. Prediction of wave motion in bays and harbours, theory and methods for calculating forces on structures. Written for engineers, emphasis on calculation. Illustrated.

Gerritsen, F. and Yücel, F.A., Tsunami run-up in Coastal Regions, Summary in Int. Conf. on Natural and Man-Made Coastal Hazards 1989, p. 166 - 170 (IOS).
A computational method to determine run-up of tsunami waves on dry land as a bore, including slope, bottom friction and breaking. Diagrams given for estimating bore dissipation length.

Gonzales, F.I., Bernard, E.N., Milburn, H.B., A Program to Acquire Deep Ocean Tsunami Measurements in the North Pacific, "Coastal Zone '87" WW Div./ASCE, Seattle WA/May 26-29 1987, 5 pp. (FL)
There have been very few observations made that can be used to design or verify mathematical modelling. Results depend on the assumptions. There is a need for deep water sensors to measure wave amplitudes, especially from the Shumagin Gap.

Goto, C., and Shuto, N., Run-up of Tsunamis by Linear and Non-Linear Theories, in Coastal Engineering Vol. 1 proc. 1980, p. 695 - 707 (IOS).
The topography of the land where a simulated tsunami reaches the shore determines the run-up. The authors compare linear and non-linear sets of equations for simple topography with satisfactory results. This is of fundamental importance to defining land areas at risk.

Henry, R.F., Automated Programming of Explicit Shallow Water Models, Part 1, Can. Tech. Report of Hydrography & Ocean Sciences, No. 3, 1982. (IOS)

Improvements to the mathematical modelling of tsunami waves.

Kowalik, Z., and Murty, T.S., (1992) Numerical simulation of two dimensional tsunami run-up (in preparation).
State of the art mathematical model of Alberni Inlet, includes loss of energy due to run-up at shoreline discontinuity. The predicted wave shape more closely describes the 1964 Alaska event than previous studies.

Kowalik, Z. and Murty, T.S. On Some Future Tsunamis in the Pacific Ocean in Natural Hazards 1. (1989) 349-369, Kluwer Academic Pub.
Modelling of tsunamis assuming Shumagin Gap and St. Augustine volcano (Cook Island). Prediction of Shumagin source event based on 50 year cycle. Prediction of direction of maximum amplitude in a south and southeasterly direction.

Mader, C.L., Numerical Tsunami Flooding Study in Science of Tsunami Hazard, Journal, Vol. 8, No. 2, 1990 7 pp. (FL).
Describes modelling of tsunami waves on beaches. Uses the SWAN code to study the effect of tsunami period, amplitude, bottom slope angle and friction (using Chezy coeff.) on tsunami shoaling and flooding. Compares with the Bretschneider model using Manning coeffs. Interaction of rundown with second and third wave can be modelled. Importance of estimating friction.

Murty, Dr. T., Seismic Sea-Waves, Tsunami, Bulletin 198 of Fisheries Research Board of Canada, 337 p., 1977.
Complete book on tsunami; generation, propagation, coastal action, global tsunamis, warning systems; seismology - general dissertation applicable to world-wide events.

-------, Commentary on Garcia & Houston in Murty, Bulletin 198, p. 195, 1976 (RB, ML).
Explanation of math. used in modelling for Southern California.

-------, Dynamic Similarities and Differences between Storm Surges and Tsunami, in Storm Surges, Observation & Modelling, China Press, 1987, p. 3 - 17 (IOS).
Compares the modelling for storm surges and tsunami waves, both long gravity waves. Propagation, boundary conditions, interaction with tides. Topographic resonance more important for tsunami, but storm surges far more destructive.

Nakamura, Shigehisa, A Note on Numerical Evaluation of Tsunami Threats by Simple Hydrodynamic and Stochastic Models Referring to Historical Descriptions in Bull. Disas. Prev. Res. Inst., Kyoto Univ., Vol. 37 Part 1 No. 322, March 1987, 18 pp. (FL).

Historical damage maps show how tsunami affected Tanabe and Shirahama in Japan, for 1707, 1854, 1946 and 1960 (source off Chile). Historical records date back to 684 A.D. This information is combined with numerical modelling to predict wave heights for long term planning of protective works. Important to combine historical and numerical information for best predictions.

Pararas-Carayannis, G., An analysis of the Dispersive Characteristics of the 7 May 1986 Tsunami in Tsunami Newsletter, April 1987, Vol. XX, No. 1, pub. Int. Ts. Info. Centre, Honolulu, Hawaii, 1987, 5 pp. (FL).

As part of the tsunami warning system, it is expected that observation of wave height following a seismic event will enable prediction of wave height at a more distance point. In the 1986 event, the observed heights do not fit normal patterns. Dispersion is only one of the factors in final wave height; source mechanism and energy are also important.

-------, Risk Assessment of the Tsunami Hazard in Natural and Man-Made Hazards, p. 171 - 181, pub. D. Reidal, 1988 (LL)

Provides guidelines and methodology needed for the evaluation of the tsunami risk in terms of frequency of occurrence, severity of impact, preparedness and planning for hazard mitigation. Historical studies and modelling can lead to better definition of hazard zones.

Preisendorfer, Rudolf, Recent Tsunami Theory, (development of mathematical analysis), Hawaii Institute of Geophysics, Honolulu, 1971 (IOS).

Recent developments (to 1971) are discussed. The five main phases of the development of the tsunami are described with mathematical modelling. These are: generation and uniform propagation, scattering and diffraction, guiding, trapping, radiation oscillation and resonances, shoaling breaking and run-up. Covers the decade 1960 - 1970, during which there was a marked increase in sophistication of modelling.

Rapatz, W., Quoted in Victoria, B.C., Times-Colonist, 88/06/07:

"Figures of height and current speed given for inlet heads in Seaconsult report should be multiplied by 0.7".

Seaconsult Marine Research Ltd. (D. Dunbar, P. LeBlond, D. Hodgins), Evaluation of Tsunami Levels Along the British Columbia Coast, Dept. of Fisheries & Oceans, Sidney, B.C., 1988 (FL).
Important mathematical modelling study; maximum tsunami water levels and currents along the outer B.C. coast were computed, based on seismic events in Alaska (same as the 1964 event and 25% larger), from Chile, the Aleutian Islands (Shumagin) and Kamchatka. Each of these sources is modelled to arrive at 185 key locations on the coast, showing where and from which source direction the risk is highest. Compared with historical records, results tend to exagerate wave height of 2nd and 3rd waves. Only data for most of coast, except Port Alberni. Distributed as summary to MELP Regional Offices and affected communities.

Togashi, Hiroyoshi, Study on Tsunami Run-up and Countermeasure Ph.D. Thesis, Nagasaki Univ., Japan, 1981, 275 pp. (part FL).
Detailed analytical and experimental study of tsunami land run-up. The design of harbour breakwaters and land dykes for damage reduction. Wave action, foreward and reverse over-flow, reflection and harbour resonance as applied to such structures. Describes operation of local structures and historical experience of run-up.

ARTICLES

Methodology for Computing Coastal Flood Statistics in Southern California, Tetra Tech. Inc. for FEMA, 1980 (FL).
66 pp. plus extensive bibliography; a substantial source for all coastal hazards; tsunami generally not significant in Southern California.

Tsunami Newsletter, International Tsunami Information Centre, Vol. XXIII, No. 1, July 1990 (FL).

1. *Report on the 14th International Tsunami Symposium, Novosibirsk, USSR, papers on generation, propagation coastal effect, observations, seismic and tectonics, hazard mitigation, 1989. (Emphasis on how the waves interact with the shore and with obstacles on the shore.)*
2. *Problem of extreme tsunami wave height for nuclear power stations, p. 8.*

Note: Conference proceedings are listed under Section A, General.

E. FLOOD INSURANCE STUDIES IN USA

Houston, J.R., Type 19 Flood Insurance Study, Tsunami Predictions for Southern California, U.S. Army Corps of Engineers for U.S. Federal Insurance Administration, 1980 (RB, LL).
Calculations of tsunami elevations due to distant sources, 100-year and 500-year basis, math. modelling combining tsunami of different intensity from different sources with astronomical tides impacting at 240 coastal locations.

------- and Carver, R.D. and Markle, D.G., Tsunami-Wave Elevation Frequency of Occurence for the Hawaiian Islands, Hyd. Lab. U.S. Army Eng. Waterways Experimental Station, Vicksburg, Miss., U.S.A., Tech. Report H-77-16, 1977, 106 pp. (ML).
An investigation to establish frequency of occurence curves for tsunami elevations for Hawaiian Islands, using a finite element model to supplement historical data for the ten largest tsunami 1837-1976, required for the FEMA study. Noted that the three largest tsunami generated in the Aleutian-Alaskan area since 1788, occurred in 1946, 1957, and 1964, with no significant tsunami during 1837 through 1945. Importance of grid size in relation to wavelength and water depth. 1 in 100 years elevations are calculated. Wave heights predicted for coastlines. Risk calculated.

------- and A.W. Garcia, Type 16 Flood Insurance Study (West Coast of U.S.), U.S. Federal Insurance Agency, December 1978 (LL, RB).
Numerical models and run-up predictions; see 1980 Type 19 study for revised modelling.

------- and A.W. Garcia, Tsunami Run-up Predictions for Southern California, (commentary by T.S. Murty in Bull. 198) 1976 (ML).
Commentary on the mathematical modelling.

------- and A.W.Garcia, Type 16 Flood Insurance Study, Tsunami Predictions for Pacific Coastal Communities, U.S. Army Engineers, Vicksburg, 1974 (FL, RB).
Math. modelling for tsunami prediction. Earlier version of the Type 19 study (Houston 1980).

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A Status Report on the Nations Floodplain Management Activity, Interagency Task Force on Floodplain Management, U.S.A., 400 pp. 1989 (FL).
Very complete account of progress and problems.

National Flood Insurance Act, FEMA, USA, Federal Regulations, 1968 (RB).
Legal basis for floodplain management in USA, subsequently ammended.

Procedures for Conduct of Flood Insurance Studies of Communities on the Southern California Coast, Building Research Advisory Board, NAS, 1978 (FL, RB).
Concerns severe storm-induced surges and flooding in Southern California. Discussion of methodology for statistically combining tsunami with astronomical tide.

F. FLOODPLAIN MANAGEMENT, FLOODPROOFING (GENERAL)

Association of State Floodplain Managers Inc. (ASFPM) ASFPM Publication List.
Available P.O. Box 2051 Madison, Wisconsin USA 53701-2051 Organization sells publications re Floodplain Management, Technical Reports, State Programmes, Conference Proceedings.

Bernard, E.N., Tsunami Hazard. A practical guide for Tsunami Hazard Reduction, reprinted from Natural Hazards, Vol. 4, Nos. 2 & 3 (1991). Kluwer Academic Publications 326 pp. (IOS).
13 papers presented at the 14th Int. Symp. on Tsunami 1989, Novosibirsk U.S.S.R.. Papers on observations (eg. 1987-88 Alaska events), propagation, run-up, modelling, bores.

British Columbia, The Management of Coastal Resources in British Columbia, Vol. 1 and 2, 1977. Prepared by the Coastal Zone Resource Subcommittee for the B.C. Land Resources Steering Committee (ML)
Volume 1 presented an analysis of current knowledge, problems and institutional arrangements and also of future needs (as then perceived). Volume 2 is a review of selected information on Coastal Resources, agency responsibilities, information and data gaps on coastal subjects.

Burby, Raymond J. and E.J. Kaiser, An Assessment of Urban Floodplain Management in the United States, Assn. of Floodplain Mgrs., Wisconsin, 1987 (FL, ML B946).
Overview of insurance program and effectiveness and the case for Land Acquisition.

California, State of, California Coastal Plan, prepared by the Calif. Coastal Zone Conservation Commission, 1975, 443 pp. (ML)

Principle objectives were to protect the California Coast as a great natural resource and to use the coast to meet human needs in a manner that protects the resources of land and water. This comprehensive report covers the findings of the commission, with policies and descriptions of each regional sub-section. Maps show information on forestry, agriculture, mineral extraction, recreation, development, etc.

Canada, Department of Fisheries and Environment, Inland Waters Directorate, Flood Damage Reduction Program, Literature Search on Flood Proofing, 1977, 72 pp. (FL)
79 annotated entries covering floodproofing, rehabilitation of flooded structures, durability of building materials and methods and Building Code ammendments.

Clarke, M.N., The New South Wales Floodplain Management System and Manual (Australia), Proceedings Assn. Floodplain Managers, 11th Annual Conference, June 1987, 7 pp.,(FL, RB).
Instead of a 1% flood, a designated flood is used. The method includes hydraulic and hazard analysis, floodway, flood storage and flood fringe, all based on the designated flood.

FEMA, Federal Emergency Management Agency. Coastal Construction Manual. FEMA-55 February 1986 (FL)
A complete text book for those interested in constructing in areas with high wind and water velocity (scour). Would apply to tsunami prone areas where water velocity is predicted. Pictures, sketches and tables for design of pile foundations and bracing etc.

-------, A Status Report on the Nation's Floodplain Management Activity, prepared for the Interagency Task Force on Floodplain Management by L.R. Johnston Assoc., 1989, 420 pp. FL.
A comprehensive reference document, covering in 15 chapters all aspects of floodplain (FP) management, generally the U.S. Federal involvement. Chapter headings are Floods and Flooding, FP resources and values, FP development and losses, History of FP Management. A unified national program for FP Management, Changes in FP Management since the 1960's, the Management Framework, Regulatory and Design standards, Perception awareness and response, Legal Interpretation, Modifying susceptibility, Flooding impacts, Managing natural and beneficial values, Current trends, Appendices.

Hawaii - County of, Chapter 22 Flood Hazard Control adopted May 1982, 8 pp. (FL).
Excerpt covers development and construction standards in flood and tsunami hazard areas; also FIRM map.

Oregon State, Oregon's Statewide Planning Goals 1990 Land Conservation and Development Commission, 24 pp. (FL).
Describes 19 Goals that form the statewide planning program; includes estuarine, coastal shorelands, beaches and dunes and ocean resources. Each Goal is detailed and analyzed.

Preuss, Dr. J., and Hebenstreit, G.T., Integrated Hazard Assessment for a Coastal Community, Grays Harbor, Wash. U.S.A., 1990. pub. Urban Regional Research, Seattle, Wash. (IOS).
The tsunami flood initiates a series of damage events, including fire and toxic/hazardous release. The zone of vulnerability and secondary hazards should be identified for a complete risk management plan. At this site, tsunami and high river levels are combined,

-------, Land Management in Tsunami Hazard Zones, Urban Regional Research, 1982, 258 pp. (FL).
Very useful material re: planning. Compares practice in different communities, starting with State and Regional planning. Detailed discussion of the site planning process using Kauii, Hilo and Kodiak as examples. Combines urban planning, risk management and an introduction to tsunami hazard zone identification.

-------, Planning for Risk: Comprehensive Planning for Tsunami Hazard Areas, Urban Regional Research, 1988, 246 pp. (FL).
Deep water characteristics of tsunami are fairly well understood, however, the near shore and dry land effects are much less certain. Risk assessment involves a study of historical damage patterns, risk reduction methods and a risk management program, eg. warning systems and mitigation maintenance.

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A Guide for Developing a Pre-flood Hazard Mitigation Plan for California Communities, Division of Flood Management, Dept. of Water Resources, State of California, December, 1985 (FL).
Practical guide to planning a community to reduce flood damage.

Blakely, W.J., Some observations on planning for Tsunami Prone Areas (prepared for the City of Port Alberni) May 14, 1979 33 pp. (FL)
The results of a literature search and telephone interviews with authorities in communities affected by the 1964 tsunami. Covers post-disaster response and planning for future land use.

Floodplain Shoreland Management Program, Handbook for Local Officials, Dept. of Nat. Res., Wisconsin, 1982 (FL).
Describes V zone, coastal high hazard area, substantial improvement, Federal (FEMA) regulations, Section 60.

Floodproofing Regulations, Office of the U.S. Army Chief of Engineers, 1972 (FL).
Methods and techniques, design, details, sample regulations, not specific to tsunami.

Model Floodplain and Shoreland - Wetland Zoning Ordinance for Cities and Villages, Wisconsin Dept. of Natural Resources, March, 1987 (FL).
Standard for regulating floodplain development.

Oregon's Statewide Planning Program and Planning Goals, State Land Conservation and Development Commission, 1986 (RB, FL).
Description of legislation re land use planning for floodplains and coastal zones.

Perspectives in Floodplain Management in the Pacific Northwest, FEMA, Region X, 1990 meeting report (FL).
Status of FEMA, issues, reports, acquisition program. Coastal flood hazard study methods, WHAFIS, run-up, V zones, regs. for evaluating coastal structures, types of floodway, flow concepts, erosion and fans.

Realistic Approaches to Better Floodplain Management, Proc. of 11th Annual Conference of the Assn. of State Floodplain Managers, 1987 (FL).
Includes a variety of papers on Floodplain Management.

Regulation of Flood Hazard Areas to Reduce Flood Losses, U.S. Water Resources Council, Vol. 2, parts V-VI, 389 pp., 1973 (FL, RB (parts)).
A very complete discussion of techniques and legal aspects of flood hazard areas; model ordinances, permits, etc. Includes Hawaii shoreline setback regulation.

Regulating Floodplain Development, a Handbook for Local Officials, Floodplain Management Division, Dept. of Community Planning, Dept. of Community Affairs, Commonwealth of Pennsylvania, 1978 (FL).
How communities are to fit into the National Flood Insurance Program. Includes state and federal regulations, bylaws, permits and procedures.

Washington Coastal Currents, Newsletter from Washington State Dept. of Ecology.
General Information on coastal problems.

Wisconsin's Floodplain Management Program, Dept. of Natural Resources, Ch. NR 116, 1986 (FL).
Regulations for establishing and for the use of floodplains; Lakes Superior and Michigan are important. Guide for local zoning officials and local government.

G. COASTAL ZONE MANAGEMENT

Balsillie et al., State Policies and Programs - Florida, in "Preventing Coastal Flood Disasters," Assoc. of State Floodplain Managers, Wisconsin, 1983 (FL).
The stability of the beach-dune system may be threatened by imprudent construction.

Brown, A.J., California Coastal Storms, in "Preventing Coastal Flood Disasters," Assoc. of State Floodplain Managers, Wisconsin, 1983 (FL, RB)
While studying tsunamis and their impact, this is an important reminder of other coastal hazards.

Chesneau, Lee S., The Use of Storm Surge Forecast Models in Improved Flood Management, from Proc. Floodplain Man. 1987 (FL, RB).
A reminder that the effects of storm surge and extreme storm-generated waves may be more severe than tsunami. Describes storm surge forecasting at Grays Harbour, Washington.

French and Wright, Local Implementation of Coastal Zone Management in California, in Coastal Zone '83 Conference., 1983 (RB, FL).
The problems of combining legislation and organization to control use of the coast, also preparation and approval of plans.

Gilman, C., Coastal High Hazard Area Studies, in "Preventing Coastal Flood Disasters," New Jersey, Assoc. of State Floodplain Managers, Wisconsin, 1983 (RB, FL).
Good description of the problems in showing on maps the real

extent of hazard areas. Wave heights, run-up, erosion, existing structures, mapping quality, etc., need for ongoing revision.

Lee and Olsen, Barrier Island Legislation in Rhode Island, in "Preventing Coastal Flood Disasters," Assoc. of State Floodplain Managers, Wisconsin, Assoc. of State Floodplain Managers, 1983 (FL, ML).
Coastal hazard protection may have little permanence in major storms. This should be part of legislation and design.

Lowry, K. and Okamura, N.H., Closing the Implementation Gaps in the National Coastal Zone Management Program, in Coastal Zone '83 Conference, 1983 (RB, FL).
Federal legislation, state implementation; diverse natural resources and local government; slow progress in achieving program objectives. Authority and enforcement, state legislation giving control over coastal management and county control in Hawaii. Useful discussion of the problem of devolution of responsibility and authority.

Luzier, J.M., The Land Developer's Perspective on Flood Hazard Mitigation, in "Preventing Coastal Flood Disasters," Assoc. of State Floodplain Managers, Wisconsin, 1983 (FL, ML).
The accuracy of Base Flood Elevations. Changes to elevations due to impact of waves in coastal zones.

Miller, C.D., Identification of Coastal High Hazard Areas, in "Preventing Coastal Flood Disasters," Assoc. of State Floodplain Managers, Wisconsin, 1983 (FL, ML).
Wave height study methods, surge, barrier islands.

National Research Council (Canada), Canadian Coastal Conference 1990. Short Course Notes, Kingston, Ont. Canada Pub. NRC-31503 97 pp. (FL).
Papers on Coastal Management, experiences, lessons and needs.

New England-New York Coastal Zone Task Force, "Developing Policies to Improve the Effectiveness of Coast Flood Plain Management (FL).
This is the Executive Summary, 61 pp. There are also 6 chapters of Technical Appendix on Coastal Site Selection and Development which we do not have.

Oswalt, D. and N. Coenan, Evaluating the Oregon Coastal Management Program in Coastal Zone '83, Symp. on Coastal & Ocean Man-

agement, pub. by American Shore and Beach Preservation Association and California State Lands Commission, 1983 (RB, FL).
The assessment of and need for revisions to the OCMP, difficulties in implementation. Maintaining active support for the program is important.

Platt, R.H., Local Government Liability Regarding Coastal Hazards, Assoc. of State Floodplain Managers, Wisconsin, 1983
Issues and doctrines re flood related damage.

Preuss, Jane, Coastal High Hazard Mitigation - Comprehensive Planning for Areas Vulnerable to Tsunamis, in Proc. Floodplain Managers, 1987 (RB).
Secondary causes of damage such as fire, loss of ground support, floating objects, etc., may be more important than direct water damage. All these risks should be planned for.

-------, and Hebenstreit, G.T., Integrated Hazard Assessment for a Coastal Community, Grays Harbor, Wash. U.S.A., 1990. pub. Urban Regional Research, Seattle, Wash. (IOS).
The tsunami flood initiates a series of damage events, including fire and toxic/hazardous release. The zone of vulnerability and secondary hazards should be identified for a complete risk management plan. At this site, tsunami and high river levels are combined,

-------, Planning for Risk: Comprehensive Planning for Tsunami Hazard Areas, Urban Regional Research, 1988, 246 pp. (IOS).
Deep water characteristics of tsunami are fairly well understood, however, the near shore and dry land effects are much less certain. Risk assessment involves a study of historical damage patterns, risk reduction methods and a risk management program, eg. warning systems and mitigation maintenance.

Reilly, F.V., NFIP - Individual Risk Rating for Coastal Areas, Natural Hazards Research Applications Info. Centre Sp. Pub. #7, University of Colorado, 1983 (RB, FL).
Buildings in coastal V zones are subject to damage due to wave action and foundation erosion as well as simple flooding. How to evaluate risk. High velocity water can also be expected in tsunami hazard areas.

Research Advisory Council, Surviving the Storm, Building Codes, Compliance and the Mitigation of Hurricane Damage, 1989 (FL).
Importance of Building Codes and Compliance.

ARTICLES

Coastal Homeowners' Flood Preparedness Manual, Dept. of Environmental Protection, State of Connecticut, 77 pp., 1985 (FL).
Flooding, how to prepare for it. Also applies to tsunami hazard areas.

PROCEEDINGS (held at MELP Library)

Proceedings of 8th An. Conf. Baltimore, Maryland, 1982, of the Coastal Society, 479 pp. (ML).
Papers on the investigation and management of coastal and estuarine areas.

Proceedings on (National) conference on Organizing and Managing the Coastal Zone, 1973, Annapolis, Maryland, (ML).
Papers on intergovernmental aspects, management process, uses of the Coastal zone, state and federal needs and resources.

Proceedings of the 3rd National conference on Coastal Zone Management, 1975 (ML).
Presentations and proceedings.

Proceedings, Marine Society, Los Angeles Region, Coastal Zone Management Conf., 1973 (ML).
Coastal Zone legislation, coastal technology, recreation, regulation, land use.

Proceedings of the 12th An. Conf. Assn. of State Floodplain Managers at Nashville, Tenn. 1988 (ML).
Papers on floodplain and coastal zone management.

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